UNIVERSITY OF GONDAR
FACULTY OF VETERINARY MEDICINE

PREVALENCE AND IDENTIFICATION OF MAJOR IXODID TICK GENERA OF CATTLE IN DANGILA DISTRICT, AWI ZONE, NORTH WEST ETHIOPIA

DVM THESIS

BY

HABTAMU YENENEH

JUNE, 2015
GONDAR, ETHIOPIA

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A thesis submitted to the Faculty of Veterinary Medicine, University of Gondar in partial fulfillment of the requirements for the degree of Doctor of Veterinary Medicine

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By

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LIST OF ABBREVIATIONS

AOR	Adjusted Odds Ratio
CI	Confidence Interval
COR	Crude Odds Ratio
CSA	Central Statistics Authority
FAO	Food and Agricultural Organization
SPSS	Statistical Package of Social Science
TBD	Tick Born Disease
χ^2	Chi- Square

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ABSTRACT

A cross- sectional study was conducted in Dangila District, Awi zone, from November, 2014 to April, 2015 to estimate the prevalence of major ixodid ticks on cattle and to identify the prevalent ticks to the genera level. Study animals were selected randomly. Out of the total of 384 cattle examined, 216(56.2%) were found to be infested by one or more ticks. About 864 adult ticks were collected from the animal body parts, preserved with70% alcohol and were identified to genera level by using stereo-microscope. From the total ticks collected four genera's namely; Amblyomma, Boophilus, Rhipicephalus and Hyalomma were identified and account 37.5, 25.0, 23.1 and 14.4 %, respectively. From different variables (sex, age, breed and body condition), only body condition was statistically significant with tick infestation ($p< 0.05$). The prevalence of tick infestation was found highest in poor body condition animals (62.9%) while in medium and good body condition it was found (59.4%) and (41.2%), respectively. And also in logistic regression analysis only body condition has shown statistical significant. The odd of the infestation in poor body condition was 2.4 times higher than in good body condition animals. It has also been evident that the favorable predilection sites of Amblyomma tick were ventral body parts and perineum region. Boophilus preferred dewlap, udder/scrotum, belly, leg, head, and perineum. Rhipicephalus had a strong affinity for perineum, dewlap, udder/scrotum, tail tips and ears. For Hyalomma the perineum region, udder/scrotum and under tail were its hiding sites. From this study we can make a conclusion that the prevalent ticks could also be responsible for transmission of tick borne diseases in addition to their physical damage to the skin. Therefore, further studies should be carried out on tick burden and tick borne diseases.

Keywords: *Cattle, Dangila District, Prevalence, Tick*

1. INTRODUCTION

Ethiopia represents various climatic zones and livestock production systems in tropical Africa (Solomon *et al.*, 2001). It has the largest number of livestock in Africa, approximately 53.99 million cattle, 25.5 million sheep and 24.06 million goats, 1.91 million horses, 6.75 million donkeys, 0.35 million mules, 0.92 million camels, 50.38 million poultry and 5.21 million bee hives (CSA, 2012/13). Among livestock, cattle play a significant role in the socio-economic aspects of the life of the people of Ethiopia. In addition to the products like meat and milk, cattle provide draught power for cultivation of the agricultural lands of many peasants. Skins and hides are also important components of the livestock sector in generating foreign export earnings (Tamiru and Abebaw, 2010). Even though they are important components of the Ethiopian farming system, their contribution to food production, rural income and export earnings are far below the expected potential. This is because cattle production in Ethiopia is constrained by the compound effects of animal diseases, poor feeding and poor managements (Getachew, 1995).

Now a day, parasitism represents a major obstacle to development and utilization of animal resource. In Ethiopia ectoparasites in ruminant causes serious economic loss to small holder farmers, the tanning industry and the country as a whole through mortality of animals, decreased production, down grading and rejection of skin and hide (Tiki and Addis, 2011). As a result of their activity ectoparasites may have a variety of direct and indirect effects on their hosts. Ectoparasites commonly tick, mite and lice affect the condition of host species by the inflammation and the infection they inflict on the skin (Taylor *et al.*, 2007), and by their effect on the physiology of the animals as well as through transmission of different diseases (Wall and Shearer, 2001; Bekele *et al.*, 2011). Infestations by ectoparasites significantly affect the quality of hide thereby affecting the economy of Ethiopian farmer's as well as international market (Bekele, 2002).

Ticks are the most important ecto-parasites of livestock in tropical and sub-tropical areas, and are responsible for severe economic losses in livestock. The major losses, however, caused by ticks are due to their ability to transmit protozoan, rickettsial and viral diseases of livestock, which are of great economic importance world-wide. Tick-borne protozoan diseases (example: Theileriosis and Babesiosis) and rickettsial diseases (example: Anaplasmosis and cowdriosis) and tick-associated dermatophilosis are major health and management problems of livestock in many developing countries. The economically most important ixodid ticks of livestock in tropical regions belong to the genera of Hyalomma, Boophilus, Rhipicephalus and Amblyomma (Frans, 2000).

A complex of problems related to ticks and tick-borne diseases of cattle created a demand for methods to control ticks and reduce losses of cattle production and productivity (George *et al.*, 2004). Control of tick infestations and the transmission of tick-borne diseases remain a challenge for the cattle industry in tropical and subtropical areas of the world. Tick control is a priority for many countries in tropical and subtropical regions (Lodos *et al.*, 2000).

In Ethiopia, there are 47 species of ticks found on livestock and most of them have importance as vectors for disease causing agents and also have damaging effect on skin and hide production (Bayu, 2005). Ticks, besides being important vectors for diseases like theilerosis, anaplasmosis, babesiosis and cowdriosis (heart water) in domestic animals; they also cause nonspecific symptoms like anemia, dermatosis, toxicosis and paralysis (Solomon *et al.*, 2001).

Even though, tick infestation in cattle was prevalent in Dangila District, the distribution and identification of ticks were not well studied. Hence, the objectives of the present study are:

- To estimate the prevalence of major ixodid ticks on cattle.
- To identify the prevalent ticks to the genera level.

2. LITERATURE REVIEW

2.1. Biology and Morphology of Ticks

Ticks are obligate; blood feeding ectoparasites of vertebrates (Wall and Shearer, 2001). They are small to medium size acarines with dorsoventerally flattened, leathery bodies (Hendrix, 1998). The ticks of veterinary importance can be divided into two families, the argasid or soft ticks and the ixodid or hard ticks (Hendrix, 1998). The division between the two families is based on the following characteristics: Ixodid :- an inflexible, dorsal scutum covers the idiosoma of the male and the anterior part of the idiosoma of the female; mouth parts are terminal and visible from above; stigmata are located posterior to coxae IV; the body is usually wrinkled. Argasidae: - the scutum is lacking; mouthparts are ventral and not visible from above; stigmata are usually located between coxae III and IV; the body is often smooth (Marquardt *et al.,* 2000).

The Ixodidae are relatively large ticks (between 2 and 20 mm), flattened dorso ventrally. The enlarged fused coxae of the palps are known as the basis capituli, which vary in shape in the different genera. Its lower wall is extended anteriorly and ventrally to form the hypostome, which lies below the chelicerae. The hypostome is armed with rows of backward barbs or teeth, and is used as an anchoring device when the tick feeds. Ventromedially there is a hypostome with recurved teeth for maintaining position; it bears a dorsal groove to permit the flow of saliva and host blood. The four-segmented sensory palps and heavily sclerotised chelicerae are anterior and visible from the dorsal surface. All ixodid ticks have a chitinous covering or scutum or aconscutum as a hard plate on the dorsal surface which extends over the whole dorsal surface of the male, but covers only a small area behind the gnathosoma in the larva, nymph or female (Walker *et al*., 2003).

Some ticks have coloured enamel like areas on the body and these are called ‘ornate ticks’. The coxa of the leg may be armed with internal and external ventral spurs, their number and size maybe important in species identification. Located on the tarsi of the first pair of legs is the Haller’s organ, which is packed with chemoreceptors, used for locating potential hosts (Mandal, 2006). Eyes, when present, are situated on the outside margin of the scutum. Adult and nymphal ticks have a pair of respiratory openings, the stigmata which lead to the tracheae. The stigmata are large and positioned posterior to the coxae of the fourth pair of legs. In adults, the genital opening, the gonopore**,** is situated ventrally behind the gnathosoma, usually at the level of the second pair of legs, and is surrounded by the genital apron. (Hendrix, 2006).

The hard ticks are of greatest importance in veterinary medicine. Various hard tick species are vectors of a number of viral, bacterial, and protozoal pathogens of animals and humans. In addition hard tick species cause tick paralysis and tick toxicosis (Zajac and Conboy, 2006). Besides markedly different morphology, these ticks vary greatly in their behavior. The argasidae family tends to be composed of species that live in nests or burrows from where they surreptitiously feed quickly on unsuspecting hosts. Ixodid ticks tend to spend most of their lives in the fields or scrub areas where they await passing hosts. These ixodid ticks then attach and remain attached to their hosts for up to several days before they release and drop to the ground (Bowman, 2003).

Specific identification of ticks is difficult and should be performed by a veterinary parasitologist or trained acarologist or arthropodologist. Ticks are usually identified by the shape and the length of the capitulum or mouthparts, the shape and color of the body, and the shape and markings on the scutum. Male and unengorged female ticks are easier to identify than engorged female ticks. It is most difficult to appreciate larval or nymphal ticks. Most ticks do not tolerate direct sunlight, dryness, or excessive rainfall (Hendrix, 2006).

2.2. Epidemiology of ticks

The distribution of ticks in a temperate climate with frequent and non-seasonal rainfall is closely linked with the availability of a micro-environment with a high relative humidity. In contrast in tropical grazing areas the grass cover on pastures is discontinuous and often interspersed with bare or eroded patches. Where suitable grass cover does exist it has been generally accepted, since temperatures are suitable for development throughout a large part of the year, that the distribution of ticks is mainly governed by rainfall. The various genera of ticks have different thresholds of temperature and humidity within which they are active and feed, and these thresholds govern their distribution (Pegram *et al.*, 1991). Generally, ticks are most active during the warm season provided there is sufficient rainfall, but in some species the larval and nymphal stages are also active in milder weather and this affects the duration and timing of control programmes (Urquhart *et al.*, 1996). A tick's habitat is composed of the variety of living and non living things in the space in which it lives that are good or bad for its survival. Dry environmental conditions are a serious danger to ticks, particularly to the questing larvae which are very susceptible to drying out fatally. The survival of many species is improved if they have a seasonal cycle which reduces these risks. This is followed by peak numbers of larvae toward the end of the wet season when humidity is highest (Walker *et al*., 2003).

2.3. Life cycle of ticks

The life cycles vary considerably, some ticks spending all their time on a single host, others are only parasitic at certain stages and some spend each stage of the life cycle on a different host. Those spending all their time on a single host are easier to control than those on different hosts for each development stage (Andrew *et al.,* 2004). There are four major stages in the life cycle of ticks: egg, larva, nymph, and adult. Following their engorgement on the host, female ticks drop off the host and seek protected places, such as in cracks and crevices or under leaves and branches, to lay their eggs (Hendrix, 2006). According to the numbers of hosts, Ixodid ticks are classified as one-host ticks, two-host ticks and three-host ticks. In one-host ticks, all the parasitic stages (larva, nymph and adult) are on the same hosts; in two- host ticks, larva attach to one host, feed and molt to nymphal stage and engorged, after which they detach and molt on the ground to adult; then adult male as well as female ticks then look for another host, feed on blood and copulate. After 6-11 days, the female drops to the ground and deposits its eggs. And in three-host ticks, the larva, nymph and adult attach to different hosts and all detach from the host after engorging, and molt on the ground (Taylor *et al.*, 2007).

All ticks pass from the egg through larval and nymphal stages before becoming adults and utilize one or more host animals during the developmental cycle. Eggs are always laid in the environment. Hard tick larvae are acquired by the host from the environment. All hard ticks undergo a single molt from the larval to the nymphal stage and a second molt from the nymph to the adult. These molts follow attachment and blood feeding on the host that usually lasts for several days. Tick species that remain on the host during the two molting period are known as one-host ticks. In two- host tick species, the molt to the nymphal stages occurs on the host, but the engorged nymphs leaves the host, molts in the environment and then finds a new host. In the three- host tick life cycle, both the larva and the nymph leave the host to molt, attaching to a host again after each molt. Because of the different time spent in each stage on the ground, the entire development cycle may last up to one year (Mandal, 2006; Taylor *et al*., 2007). In some cases, each tick stage prefers the same host species; in others, host preference may vary with the stage of the tick (Zajac and Conboy, 2006).

2.4. Feeding and Reproduction

All feedings of ticks at each stage of the life cycle are parasitic. Ticks feed onto their host and attach to the skin with their mouthparts; these consist of chelicerae, hypostome and the palps. The chelicerae and hypostome form a tube which penetrates the host's skin; the chelicerae consist of moveable rods with sharp claws at the end, these cut a hole in the dermis and break the capillary blood vessels very close to the surface of the skin, forming a feeding lesion (Pegram *et al*., 1981).The feeding of ixodid ticks is slow because the body wall needs to grow before it can expand to take a very large blood meal. Males of most types of ticks feed large blood meal but do not expand like the females; they feed enough for their reproductive organs to mature. Ticks find their hosts in several ways. Some ticks live in open environments and crawl onto vegetation to wait for their hosts to pass by; this type of behaviour waiting on vegetation is called questing. Thus ingenera such as *Rhipicephalus*, *Haemaphysalis* and *Ixodes* the larvae, nymphs and adults will quest on vegetation. Adult ticks of the genera *Amblyomma* and *Hyalomma* are active hunters, they run across the ground after hosts nearby. The general behaviour of seeking hosts in an open environment is described as exophilic. Ticks such as argasids and many *Ixodes* species spend their entire life cycle in their host's nest and attach to their hosts there; this is called endophilic or nidicolous behavior (Walker *et al.*, 2003; Mandal, 2006).

In the hard ticks mating takes place on the host, except with *Ixodes* where it may also occur when the ticks are still on the vegetation. Male ticks remain on the host and will attempt to mate with many females whilst they are feeding. They transfer a sac of sperm (spermatheca) to the female. The females mate only once, before they are ready to engorge fully with blood. When they finally engorge they detach from the host and have enough sperm stored to fertilize all their eggs. Female hardticks lay many eggs (2,000 to 20,000) in a single time (Upadhayay, 2005).

2.5. Pathogenic role of ticks

Ticks have cytolytic effects on the hosts. The primary attachment lesion causes cytolysis following production of the hyaline sheath. There is itching accompanied by a tissue and humoral reaction of the host, with hyperemia, eosinophil infiltration and a local edematous reaction (Decastro, 1997).
The pathogenic effects are associated with the feeding mechanism of the parasite which is ideal for both penetrating the skin and transmitting micro-organisms. The dorsal groove in the hypostome provides a channel for the saliva to flow into the host and subsequently, blood and lymph into the tick (Urquhart *et al.*, 1996).The greatest importance of ticks attaches to the large number and variety of microbial diseases that they transmit among domestic animals. Other injuries inflicted by ticks include toxicosis, the bite wound, worry, and blood loss (Bowman, 2003). Many ticks are active blood feeders and may cause death from anemia (Radostitis *et al.,* 2007).

2.4.1. Direct effects

Feeding by large numbers of ticks causes reduction in live weight and anemia among domestic animals, while tick bites also reduce the quality of hides. Apart from irritation or anemia in case of heavy infestations, tick can cause severe dermatitis (FAO, 1998). At the site of a tick bite focal necrosis and hemorrhage occur, followed by an inflammatory response, often involving eosinophils. Tick bite wounds can become infected with staphylococcus bacteria, causing local cutaneous abscess or pyaemia (Wall and Shearer, 2001). Generally tick parasites generate direct effects in cattle in terms of milk production and reduce weight gain (Radostitis *et al.,* 2007).

2.4.2. Indirect effects (as Vector of pathogens)

Ticks can be carrier of pathogens, which they transmit from host to host during blood sucking and cause a large variety of diseases (FAO, 1998).The major diseases include Babesiosis, Anaplasmosis, Theileriosis, heart-water and East Coast fever; in addition, other diseases of lesser importance cause severe economic losses to the livestock industry (Drummond, 2007).

2.5. Economic importance of ticks

Ticks are most numerous, particularly in tropical and sub-tropical regions, and their impact on animal health and production is greatest in these regions (Lefevre *et al.,* 2010). The medical and economic importance of ticks has long been recognized due to their ability to transmit diseases to humans and animals. Ticks cause great economic losses to livestock, and adversely affect livestock hosts in several ways. Loss of blood is a direct effect of ticks acting as potential vector for haemo-protozoa and helminth parasites. Blood sucking by large numbers of ticks causes reduction in live weight and anemia among domestic animals, while their bites also reduce the quality of hides. However, major losses caused by ticks are due to their ability to transmit protozoan, rickettsial and viral diseases of livestock, which are of great economic importance world-wide.

2.6. Prevention and control of tick parasites

Tick biology data are fundamental factors in chemical control and biological control. Procedures directly affecting the microhabitat and host availability such as using hyperparasites and predators, and immunological control form a part of an integrated biological control program. Entomopathogens are group of organisms that attack ticks and insects and therefore are used in biological controlling of ticks. In biological the activities of the hyperparasites *chalcid flies Hunterellus* are probably important in nature, but they are difficult to evaluate. It is still more difficult to manipulate or reproduce them for practical use. Predators are most effective, especially ants and birds (*Buphagus species,* or *oxpeckers*, *Crotophagus,* various magpies, village fowl). Depending on the conditions, these predators can consume a large number of ticks (Okello *et al*., 2003).

There are quite a few methods for chemical controlling of ticks, but every method has certain shortcomings (Rajput *et al.,* 2006). Treatment of hosts with acaricides to kill attached larvae, nymphs, and adults of ixodid ticks and larvae of argasid ticks has been the most widely used control method. In the first half of the century, the main acaricide was arsenic trioxide. Subsequently, organochlorines, organophosphates, carbamates, amidines, pyrethroids, and avermectins have been used in different parts of the world. The introduction of new compounds, such as the phenylpyrazoles, has been necessary because of the development of resistance in tick populations (Michael, 2011).

Toward the end of the nineteenth century a complex of problems related to ticks and tick-borne diseases of cattle created a demand for methods to control ticks and reduce losses of cattle. The discovery and use of arsenical solutions in dipping vats for treating cattle to protect them against ticks revolutionized tick and tick-borne disease control programs. Arsenic dips for cattle were used for about 40 years before the evolution of resistance of ticks to the chemical, and the development and marketing of synthetic organic acaricides after World War II provided superior alternative products. Most of the major groups of organic pesticides are represented on the list of chemicals used to control ticks on cattle. Unfortunately, the successive evolution of resistance of ticks to acaricides in each chemical group with the concomitant reduction in the usefulness of a group of acaricides is a major reason for the diversity of acaricides. Whether a producer chooses a traditional method for treating cattle with an acaricide or they are using a new method, they must recognize the benefits, limitations, and potential problems with each application method and product (George *et al.,* 2004).

The main reasons for tick control are to protect hosts from irritation and production losses, formation of lesions that can become secondarily infested, damage to hides and udders, toxicosis, paralysis, and of greatest importance, infection with a wide variety of disease agents. Control also prevents the spread of tick species and the diseases they transmit to unaffected areas, regions, or continents. Control of ticks with acaricides may be directed against the free-living stages in the environment or against the parasitic stages on hosts (Michael, 2011).

3. MATERIALS AND METHODS

3.1. Study area

The study was conducted in Dangila District at DangilaVeterinary Clinic. Dangila is found in Awi administrative zone, Amhara national regional state and located 78 kms away from Bahir Dar and 485kms from Addis Ababa. Geographically, the area lies between 11.3^{o} latitude and 36.8^{o} longitude with an elevation of 2137 meters above sea level. Dangila is bordered on the South by Faggeta Lekoma, on the South West by Guangua**,** on the North West by the Jawi, and on the North East by the Mirab Gojjam Zone. Towns in Dangila district include Addis_Alem, Dangila and Dek. Part of the Dangila was separated to create Jawi woreda. The general climate is moist subtropical (*woina Dega)* characterized by moderate temperature and sufficient *kiremit* rainfall. Based on records at Dangla town, the mean annual temperature is about 17^{o}c and the annual rain fall is 1578mm.

Based on the 2007 national census conducted by the Central_Statistical_Agency of Ethiopia (CSA), this woreda has a total population of 158,688, of whom 80,235 are men and 78,453 women; 27,001 or 17.02% are urban inhabitants. According to the Dangila Woreda Rural Development and Agricultural Planning Office (DAWRDAPO, 2014) the district has a livestock populations of cattle, 152032(local) and 4017 (cross), sheep (58243), goats (19659), mules (423), horses (564), donkeys (1050), poultry (87946) and bee colonies are kept in three categories of bee hives: traditional (1050), transitional (135) and modern (868) bee hives.

3.2. Study design and Methodology

A cross-sectional study was conducted from November 2014 to April 2015 in Dangila district. Active data was generated from randomly selected cattle. In this study, a simple random sampling technique was employed. Cattle which were included in the sample were examined carefully for the presence or absence of ticks on their body parts. Then the collected ticks were carefully examined to group them in to their genera using the guide indicated in Walker *et al* (2003).

3.3. Study population

The study subjects were cattle of different breed, age and sex brought to Dangila veterinary clinic. A total of 384 animals (local and cross breed) were randomly selected and examined, which are managed under extensive system. The age, sex, breeds and body condition scores of each animal was also recorded.

3.4. Sample size determination

The total number of cattle required for the study was calculated based on the formula given by Thrusfield (2005). By rule of thumb where there is no documented information about for the prevalence of tick infestation in the study area, it is possible to take 50% prevalence as minimum expected prevalence. In this study the sample size was calculated using 50% prevalence with 5% desired level of precision and 95% of confidence interval.

$$\mathrm{n} = \frac{1.96^2 \mathrm{Pexp}(1 - \mathrm{Pexp})}{d^2}$$

Where: n = sample size;

Pexp = minimum expected prevalence = 50%

1.96 = the value of z at 95% confidence interval

d = desired accuracy level at 95% interval.

As a result, 384 study populations were selected.

3.5. Samples and sampling methods

Ticks were collected manually from their attachment site in the host animals which were brought to Dangila veterinary clinic by using sampling bottle containing 70% alcohol. Then samples were transported to Bahir Dar regional laboratory for the identification of the major ixodid ticks to the genera level. According to Aiello and Mays (1998), the study populations were categorized into three age groups these are <1 year, 1-3years and >3years), breed (local and cross) and Ferguson (2011) divide the body condition score as (poor, medium and good).

3.5.1. Tick collection and identification

After the selected animals were restrained properly, all visible adult ticks were collected from their half body part manually by using forceps. Ticks with their intact mouthpart were collected carefully for proper identification and they were preserved in 70% alcohol as outlined in Jana and Ghosh (2011). Then it was labeled with the date of collection, age and sex of the hosts. They were identified by using a stereomicroscope according to standard identification keys given by (Walker *et al.,* 2003). During processing, the tick sample in each sampling bottle were transferred to a petridish, unwanted foreign materials such as hair, dry skin and other dirt were removed. The ticks then spread on filter paper to absorb excess preservative fluid. Ticks with dirty scutum were rubbed on filter paper to make them clean and easy for identification (Walker *et al.,* 2003). The count of ticks from half body zone of each animal was doubled to give the total number of ticks per animal, assuming equal number of infesting ticks on both sides of an animal.

3.6. Data analysis and presentation

The data was checked, coded and entered in to Microsoft excel work sheet and was analyzed using SPSS software version 16. Descriptive statistics like percentage was used to express prevalence while chi-square ($\chi 2$) test , binary and multivariate logistic regression were used to compare the association of tick infestation rate with sex, breeds, age groups as well as body condition scores. In all the cases, 95% confidence level and 0.05 absolute precision errors were considered. A p-value $\leq$ 0.05 will be considered statistically significant.

4. RESULTS

4.1. Prevalence and distribution of ticks

The overall prevalence of ticks from the total examined cattle was found 56.2% (216/384). In this study a total of 384 animals were examined. Among these 341 (88.8%) were local and 43 (11.2%) were cross breeds. A total of 864 adult Ixodidae ticks were collected from half body region of infested cattle. In general, four Ixodidae tick genera were identified from the study area. From identified generas; *Ambylomma* (37.5%) was the most abundant and widely distributed genus followed by genus Boophilus (25.0%). However, *Hyalomma* (14.4%) was found to be the least abundant genera (Table 1).

Table 1:Prevalence of tick genera of cattle in Dangila District

Genus	Percentage of total ticks
Ambylomma	37.5% (324/864)
Boophilus	25.0 % (216/864)
Rhipicephallus	23.1 % (200/864)
Hyalomma	14.4 % (124/864)

The prevalence of ticks in less than one year, one to three years and greater than three years was found to be, 38.6, 57.9 and 58.6% respectively. Based on their sex variation it was 53.5% in males and 60.1% in female animals. Variation in breed also occurs, in that local breeds were affected less as compared with cross breeds; 55.7% and 61.0% respectively. Poor body conditioned animals were found severely affected with ticks than medium and good body condition animals as seen in (table 2).

Table 2. Prevalence of ticks with relation to different risk factors in both cross and local cattle breeds in Dangila District.

Risk Factors	Animals Examined	Animals Positive	Prevalence (%)	P-value	x^2
Age					
Less than one year	38	14	36.8		
One to three years	126	73	57.9	0.15	3.76
Greater than three years	220	129	58.6		
Sex					
Male	226	121	53.5	0.20	1.63
Female	158	95	60.1		
Body condition score					
Poor	159	100	62.9		
Medium	128	76	59.4	0.02	12.24
Good	97	40	41.2		
Breed					
Local	343	191	55.7	0.51	0.41
Cross	41	25	61.0		

Table 3: Logistic regression analysis of tick infestation with different risk factors (variables): both binary and multiple logistic regressions.

	Tick infestation		OR(at 95% CI)		P-value
Variables	**yes**	**no**	**COR**	**AOR**	
Body conditions					
Good	40	57	1.0	1.00	
Medium	76	52	2.1(1.218-3.561)	2.3(1.309-3.9029)	P=0.001
Poor	100	59	2.4(1.441-4.043)	2.4(1.389-3929)	*
Age					
Below 1 year	14	24	1.00	1.00	
1-3 year	73	53	1.9 (0.898-3.083)	0.789(0.388-1.593)	P>0.05
Above 3years	129	91	1.3(0.657-2.609)	1.4(0.893-2.248)	
Sex					
Male	121	95	1.0	1.00	P>0.05
Female	105	63	1.3(0.867-1.976)	0.8(0.540-1.278)	
Breed					
Local	191	152	1.0	1.00	P>0.05
Cross	25	16	1.2(0.641-2.412)	0.7(0.359-1.438)	

**indicates the statistically significant variable both in binary and multivariate logistic regression*
Key*: OR- odd ratio, COR-crude odd ratio, AOR- adjusted odd ratio*

Body condition was statistically significant associated with tick infestation at which the odd of engaging the disease in poor body condition were 2.4 times higher than cattle that have good body condition. In binary and multivariate logistic regression analysis of different variables (age, sex and breed) were not statistically significant associated with tick infestation in this study.

Ticks body part distribution**:** The study was also investigated the types of ticks genera and their spatial distribution on the body of the animal. Ticks were found widely distributed in different parts of the hosts' body such as ear, neck, tail, mammary gland, brisket, belly, udder/scrotum, and perinial region. Of these sites udder/scrotum, dewlap, anal area and tail regions were most infested parts of the animal’s body and face and neck was the least affected (see table 4 below).

Table 4. Proportion and host body site distribution of ticks

Species of ticks	Number of ticks	Predilection sites
Amblyomma	324	Scrotum, udder, brisket, belly, dewlap, vulva, perineum
Boophilus	216	Dewlap, ears, scrotum, brisket, udder, flank, legs
Hyalomma	124	Udder, scrotum, tail, anus
Rhipicephalus	200	Ear, dewlap, brisket, udder, tail, vulva, anus

5. DISCUSSION

Different tick genera's are widely distributed in Ethiopia and a number of researchers reported the distribution and abundance of ticks in different parts of the country (Solomon *et al*., 2001; Goshu *et al*., 2007). In the present study, the total tick infestation prevalence was found 56.2%. This finding is greater than the reports of Kassa and Yalew (2012) with a prevalence of 33.21% in Haramaya district and Tesfaheywet and Simeon (2013) a prevalence of 16.0% in Benchi Maji Zone of the Southern Nations and nationalities of Ethiopia. In contrast to this Nigatu and Teshome (2012) were reported a higher prevalence of ticks (89.4%) from Western Amhara Region. The lower result of the present study may due to the application acaricides and different methods of prevention and control strategies.

Amblyomma, Boophilus, Rhipicephalus and Hyalomma were the four important genera of ticks encountered during the study period, with a total prevalence of 37.5 25.0, 23.1 and 14.4% respectively. The genus Boophilus tick was greater in prevalence in this study (25%) than Tiki and Addis's report (18.13%) in 2011 in and around Holeta, and Tamiru and Abebaw's (2010) in Asella (15.4%). But it was reported in a greater prevalence rate (45%) than the current study (25%) in Bossena and Abdu's (2012) study in and around Assosa. Amblyomma tick infestation was indicated higher in studies of Tiki and Addis (2011), Kassa and Yalew (2012), Tamiru and Abebaw (2010) and Bossena and Abdu (2012) with a prevalence of 50.5, 47.16, 60.1 and 45% respectively. The genus Hayalomma tick (14.4%) prevalence in this study was much greater than Tiki and Addis's report (1.85%) in 2011 in and around Holeta. In contrast to this higher result of Hyalomma tick was recorded in Gedilu *et al* (2014) study in Bahir Dar. A greater result of Rhipicephallus tick was recorded in Gedilu *et al* (2014) study in Bahir Dar (48.1%) than the current study (23.1%). But, studies by Nigatu and Teshome (2012) indicated lesser prevalence of 6.6% from western Amhara Region.

Risk factors (sex, age, breed and body condition scores) were also involved in the variations of the prevalence of ticks in the study area. The prevalence of ticks was 62.9, 59.4 and 41.2% in poor, medium and good body condition scores. It appears with statistical significance association where the p value is less than 0.05 (P=0.02) and chi-square 12.24. Similar finding was indicated in Bossena and Abdu (2012). And also it has been lined with the study made by Gedilu *et al* (2014).

This result disagree with the statement given by Kassa and Yalew (2012) and Tesfaheywet and Simeon (2013) because there existed no statistical significant difference (*P*>0.05) in the prevalence of ticks among the body condition score categories of cattle breeds. This could be related to the management system where animals are allowed to graze together in communal fields in the mixed farming system of the study area. And also in binary and multivariate logistic regression analysis body condition was statistically highly associated(P=0.001) with tick infestations in which the odds of engaging with tick infestation in poor body condition cattle was 2.4 times higher than those animals having good body conditions. The higher prevalence of ticks in the poor body condition scores than other counter parts could be due to the less resistance of weak animals to ticks infestation as a result of low immunity.

The difference in prevalence was found statistically insignificant (*P*>0.05) between sex of cattle. Male animals were found less affected than females (in male 53.5% and in female it was 60.1%) with no statistical significance (*P*- value>0.05 and x^2 = 1.63). This result is in line with the other author in Benchi Maji by Tesfaheywet and Simeon (2013) but it disagreed with the previous works in Assosa by Bossena and Abdu (2012) that the difference in prevalence was found statistically significant between sex groups. This result is also concurred with the results of Kassa and Yalew (2012) where the p-values were greater than 0.05. This might be due to equal opportunities of oxen and cows to tick infestation in their production as well as in their management condition.

Age also matters in the prevalence of ticks in cattle in the study area. In those less than one year it was 36.8% while in one year to three year and greater than three years were 57.9 and 58.6% respectively. But there is no statistical significance difference (*P*> 0.05) between the age groups. Similar findings were reported by Kassa and Yalew (2012) and Tesfahewet and Simeon (2013). However, Bossena and Abdu (2012) reported that exist statistical significance difference in the age group. And also it contradicts the study made by Gedilu *et al.*, (2014) the difference in prevalence among the age groups were statistically significant (*P*<0.05, x^2 =93.040) and he stated that the higher prevalence were recorded in animals >3years (85.1%). In general, the prevalence of ticks in all the researchers indicated that very young animals are affected less than adult animals. This could be due to the less exposure to field grazing with other animals in the field and adults are exposed due to the communal grazing habit.

Local breeds (55.7%) were affected less than the cross breeds (61.0%) but with no statistical significance differences ($p>0.05$). This result was disagreed with the findings of Kassa and Yalew (2012) who reported the prevalence of tick infestation was significantly higher ($P<0.05$) in local breed cattle (58.18%) than cross breed ones (10.55%) and Tamiru and Abebaw (2010); the burden of ticks on cattle had statistically significant difference ($P<0.05$) between local (mean=13.1 tick/head) and crossbreed (mean=21.4 tick/head) breed cattle. However, this finding agrees with the findings of Tamiru and Abebaw (2010) in that the prevalence of ticks was higher in the cross breeds than local breeds. This might be due to cross breed animals are genetically less resistance for any disease conditions than local breed animals. And also the management system plays a great role for the variation of tick infestation in different breed of animals.

6. CONCLUSION AND RECOMMENDATIONS

The important and abundant tick generas investigated in this research ranking first and second were *Amblyomma* and Boophilus followed by Rhipicephalus and lastly Hyalomma. The study indicated that there was high burden of ticks in the study area. However, the attention given to controlling the infestation had not been sufficient. The control methods necessary for tick and TBDs were selection of tick resistance cattle, acaricides treatment, appropriate livestock management, evaluation and incorporation of traditional practices or remedies that appear to be of value. Generally, the distribution of ticks are not fixed but are determined by a complex interaction of factors such as climate, host density, host susceptibility, grazing habits, and pasture-herd management. Therefore, effective tick control program should be formulated and implemented based on the distribution pattern of ticks and factors responsible for their distribution. Based on of the above conclusion the following recommendations are forwarded:

- Further studies on factors affecting tick burden and tick control strategies as well as on tick borne diseases should be conducted.
- Community should be well informed about the proper control and care of their livestock from ecto-parasite in general and about tick in particular
- Appropriate pasture management in communal grazing area is important.
- Tick control program (Application of acaricides) should be continued with an increasing frequency of application in wet months and acaricide resistance tick species should be detected since this is economically important because limited types of acaricide were used in the area.

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8. ANNEXES

Annex 1: Sample Collection Format

SN	Breed		Sex		Age			Body condition			No. of ticks identied	Lab. Result
1	L	C	M	F	<1	1-3	>3	P	M	G		
2												
3												
4												
5												
6												
7												
8												
9												

Annex 2. Identification criteria for different types of ticks

Characteristics	Amblyomma	Hyalomma	Rhipicephalus	Boophilus
Gnathosoma	Long	Long	Short	Short
Basis capituli	Rectangular dorsally	Rectangular dorsally	Hexagonal dorsally	Hexagonal dorsally
Coxae I	With two spurs	Bifid	With two spurs	Bifid
Festoons	Present	Present/absent	Present	Absent
Ornamentation of scutum	Ornate	Ornate/ inornate	Inornate	Inornate

Source: Walker (2003)

Annex 3. Age determination based on dental characteristics/formula

Age	Characteristic change
1.5-2	I_1 Erupts

2-2.5	I_2 Erupts
3	I_3 Erupts
3.5-4	I_4 Erupts
5	All incisors and canine are wear
6	I_1 is level and the neck has emerged from the gum
7	I_2 is level and the neck is visible
8	I_3 is level and the neck is visible, I_4 may be level
9	I_4 is level and the neck is visible
10	The dental star is squire in I_1 and in all teeth by 12 years
15	The teeth that are not fallen out are reduced (small round pegs).

Note: canine of ruminant is usually considered as 4th incisor. I- Incisor

Source: Torell *et al* (2003).

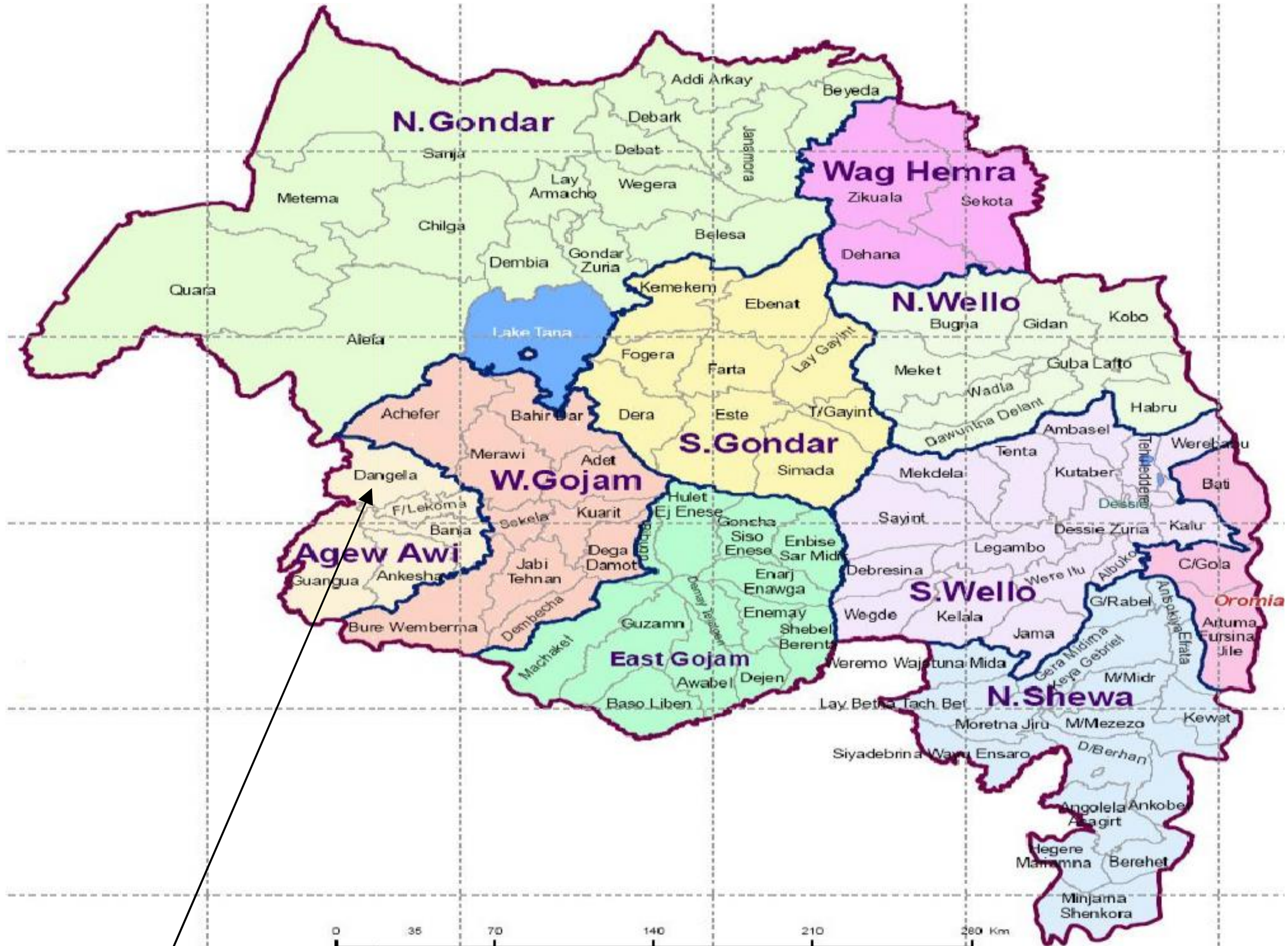
Annex 4. Body condition scoring

Thin=poor	
score1	Emaciated; starving and weak; the entire body is extremely thin, and all skeletal structures are prominently visible. No muscle tissue is evident and. All the skeletal structures are visible and very sharp to the touch. The hair coat appears to be very dull. Survival during stress is doubtful
Score 1.5	Very thin, somewhat emaciated; The vertebrae along the top line are prominent. The hooks and tail head are visually less prominent. There is no fat around the hip bone and pin bone and tail head
score2	The animal is thin. The vertebrae along the top line are prominent. Muscle tissue is evident, but not abundant. Individual vertebrae can be felt, but are not as sharp. The short ribs can be identified individually when touched, but they feel sharp rather than very sharp. Individual ribs can be identified visually. There is some tissue cover around the hook and tail head.

Optimum=medium	
score2.5	Individual ribs noticeable but overall fat cover is lacking; increased musculature through shoulders and hindquarters; hips and short ribs feel slightly round versus sharp.
Score 3	3 Increased fat cover over ribs, and ribcage is only slightly visible. Muscle tissue is nearing the maximum. Generally only the 12 and 13 ribs are individually distinguishable. There are obvious fat deposits behind the front shoulder. Areas on each side of the tail head are fairly well filled but not rounded
Score 3.5	Back, ribs, and tail head slightly rounded and feel spongy when palpated
Fat=good	
Score 4	Moderately fat the bone structure is no longer noticeable. The skeletal structure is difficult to identify. Individual short ribs cannot be felt even with firm pressure. Folds of fat are beginning to develop over the ribs and thurl area of the animal. Fat cover around the tail head is evident on both sides as slight "rounds" that are soft to the touch.
Score 4.5	Fat; very fleshy, squared appearance due to excess fat over back, tail head, and hindquarters. Individual short ribs cannot be felt even with firm pressure. Mobility may begin to be restricted
Score 5	Very fat or obese - The animal has a "blocky" appearance. The bone structure is not noticeable. The back bone has a flat appearance and cannot be felt even with pressure. Folds of fat are apparent over the ribs, thurl and thighs. The hip bones and tail head to pin area on both sides are completely buried in fat. The animal's mobility is impaired by the large amounts of fat

Source: Ferguson(2011)

Annex 5. Map of the study area



Study area

Source: http://www.ocha-eth.org/Maps/downloadables/AMHARA.pdf [accessed on: June 7/2015]

9. DECLARATION

I, the under signed, declare that the information presented here in my thesis is my original work, has not been presented for degree in any other university and that all sources of materials used for the thesis have been duly acknowledged.

Name: Habtamu Yeneneh

Signature: ____________________

Date of submission: 13/06/2015

This thesis has been submitted for examination with my approval as university advisor.

Name: Dr. Bemerew Admassu

Signature: ______________________